5 February 1973

MEMORANDUM FOR:

SUBJECT:

INTRODUCTION

The following observations and opinions pertain to:

a. the concept of field effect monitoring

b. the equipment delivered by the

c. suggestions for further research

STATEMENT OF THE TECHNIQUE

A short antenna (e.g., 18" of wire mounted vertically in the air above an insulating support) will take on an electrical potential which will vary in response to the time variation of the electrical field in its vicinity. In particular,

cause cyclic variation of the potential on the antenna which correlates to the Consider the instantaneous potential on the antenna to be a scalar, uniform over the surface of the antenna (its length is very much smaller than the wave length of the signal, e.g., 60 Hz has a wave length of 3100 miles).

The amplitude of the signal is a function of the magnitude of the the antenna distance, the relative humidity, the the degree of static charge of the to name just a few. The signal frequency range extends from DC to less than 100 Hertz.

## LIMITATIONS OF THE TECHNIQUE

A major problem with using such an antenna to intercept [redacted] is its sensitivity to extraneous signal sources. It would be useful to select one out of a set of potential sources by means of some appropriate combination of shielding or enhanced directivity of the antenna.

Antenna theory suggests that directivity cannot be enhanced by means of antenna configuration for all practical purposes because the antenna size and the spacing between elements of an antenna array will always be vanishingly small compared with a wavelength. The wave length of 100 $H_Z$ wave is:

$$\lambda = \frac{c}{f} = \frac{3 \times 10^8 \text{ m/sec}}{10^2 \text{ sec}^{-1}} = 3000\text{km}$$

Therefore, shielding or shaping of the field must be used to advantage if possible.

Another present limitation of the technique is the lack of knowledge required for reliable interpretation of the signals acquired. [redacted] information should be reliable given an adequate signal-to-noise ratio, but waveform analysis for detection and evaluation [redacted] would require considerable additional research. (This comment is made prior to receipt of the [redacted] Final Report.)

Finally, since the antenna sits in the near field of the source, signals received will fall off as the cube of the distance. If the signal is tangential at 1 meter, the signal will be 18 db down at 2 meters, and 28 db down at 3 meters.

Signal-to-noise ratio is critical whenever data recording is done on a machine of finite dynamic range. (The TEAC recorder supplied has a dynamic range of about 35 db.)

## THE [redacted] PROTOTYPE EQUIPMENT

The [redacted] equipment received from the [redacted] was briefly evaluated. The unit performed much as expected, and was able to provide outputs clearly showing [redacted] from a [redacted] as distances up to about 1 meter. The signal quality rapidly deteriorates with increasing range, as expected.

The unit has a rather poor battery life, rated at three hours in the instruction manual.

The operating time could be approximately tripled by installing larger battery parks in the unused spaces of the case. A suggestion: if battery life is a serious consideration, and the unit undergoes design revisions, replace the circuitry with micropower components. Newly available operational amplifiers can run on as low as 1.75 volts, drawing a few hundred microwatts. The present equipment, exclusive of the recorder, requires about 1.9 watts. The tape recorder draws about 2.4 watts.

The unit is rather inconvenient to operate since it requires battery replacement prior to each use, and a careful set-up of gain controls under conditions closely approximating those expected operationally. As previously noted, the signal amplitude is quite range dependent and probably varies considerably with environmental circumstances such as the [redacted]. Automatic gain controls or logarithmic amplifiers should be considered in order to optimize use of the tape recorder's dynamic range.